UCRL-PROC-206865

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September 29, 2004

The Fourth International Conference on Exotic Nuclei and Atomic Masses
Pine Mountain, GA, United States
September 12, 2004 through September 16, 2004

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**EPJ manuscript No.**
(will be inserted by the editor)

# Application of the Extended Pairing Model to Heavy Isotopes

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**Abstract.** The binding energies of three isotopic chains ($^{100-130}$Sn, $^{152-181}$Yb, and $^{181-202}$Pb) are studied using the extended pairing model [1]. By using the exact solvability of the model one determines the pairing strength $G(A)$ that reproduces the experimental binding energies. For these isotopic chains, $\log(G(A))$ has a smooth systematic behavior. In particular, $G(A)$ for the Pb and Sn isotopes can be described by a two parameter expression that is inversely proportional to the dimensionality of the model space.

**PACS.** 21.10.Dr Binding energies – 71.10.Li Pairing interactions in model systems – 21.60.Cs Shell model

Exactly solvable models are essential in the understanding of various physics phenomena. For example, Elliott's SU(3) model provides a bridge between collective and microscopic single-particle shell-model description in nuclei. The pairing interaction is very important in nuclei and is also an exactly solvable. Recently, a whole new class of exactly solvable models, Richardson-Gaudin models, has been uncovered. Most of the current models, however, are mainly focused on Hamiltonians with two-body interactions, which is the currently accepted wisdom. For real applications, however, the infinite dimensional structure of the Hilbert space is a serious obstacle if the system under consideration is not exactly solvable or in a pertubative regime. In order to overcome this problem, one can construct an effective Hamiltonian in a finite model space. This, however, results in a many-body effective interaction terms. Never the less, the effective Hamiltonian approach has been applied with an increasing success, and even has pointed to the possible need of real three-body interactions in nuclei [2]. Therefore, the study of model Hamiltonians with many-body interactions would enhance our understanding of physical systems. The recently discovered exactly solvable many-body extended pairing model provides us with unique opportunity [1] for such a study. Its application to three isotope chains has shown that the model can be used for calculations of binding energies of heavy nuclei.

Financial support provided by the U.S. National Science Foundation, Natural Science Foundation of China, and the Education Department of Liaoning Province. Some of the work was also performed under the auspices of the U. S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

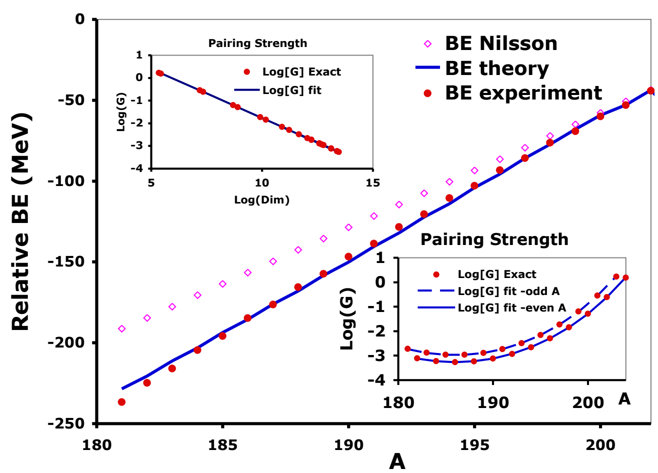


**Fig. 1.** The solid line gives the theoretical binding energy for the Pb isotopes relative to the $^{208}$Pb nucleus. The insets show the fit to the values of $G$ that reproduce exactly the experimental data using a $^{164}$Pb core. The lower inset shows the two fitting functions: $\log(G(A)) = 382.3502 - 4.1375A + 0.0111A^2$ for even values of $A$ and $\log(G(A)) = 391.6113 - 4.2374A + 0.0114A^2$ for odd values of $A$. The upper inset shows a fit to $G(A)$ that is inversely proportional to the size of the model space, $(\dim(A))$, that is valid for even as well as odd values of $A$: $G(A) = 366.7702/\dim(A)^{0.9972}$. The Nilsson BE energy is the lowest energy of the non-interacting system.

## References

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